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Case 9647(2)

Claims:

1. Particles of an esterifiable scale inhibitor cross-linked with a polyol via ester cross-links wherein the particles have a mean diameter of less than 1 micron.
2. Particles as claimed in Claim 1 wherein the esterifiable scale inhibitor is carboxylic acid-containing, organophosphorus-containing or organosulfur-containing.
- 5 3. Particles as claimed in Claim 2 wherein the carboxylic acid-containing scale inhibitor is selected from the group consisting of homopolymers of an alpha, beta-ethylenically unsaturated carboxylic acid or copolymers containing as one of its components, an alpha,beta-ethylenically unsaturated carboxylic acid.
4. Particles as claimed in Claim 2 wherein the organophosphorus-containing
10 esterifiable scale inhibitor is selected from the group consisting of organophosphates, organophosphonates and polyphosphonates.
5. Particles as claimed in Claim 2 wherein the organosulfur-containing esterifiable scale inhibitor is selected from the group consisting of homopolymers of vinylsulfonic acid, homopolymers of styrene sulfonic acid, copolymers of vinyl sulfonic acid and
15 styrene sulfonic acid, copolymers of vinyl sulfonic acid and AMPS, copolymers of styrene sulfonic acid and AMPS and copolymers of vinyl sulfonic acid, styrene sulfonic acid and AMPS.
6. Particles as claimed in any one of Claims 2 to 5 wherein the esterifiable scale inhibitor is polymeric and has a molecular weight in the range 200 to 20,000, preferably
20 800 to 10,000.
7. Particles as claimed in any one of the preceding claims wherein the esterifiable scale inhibitor is crosslinked with a polyol selected from the group consisting of

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ethylene glycol, glycerol and their higher homologs; dihydroxy-terminated polyethylene oxides or polypropylene oxides; polyvinyl alcohols and co-polymers of vinyl alcohol.

8. Particles as claimed in Claim 7 wherein the polyol has a molecular weight in the range 500 to 130,000, more preferably in the range 5,000 to 50,000.

5 9. A process for preparing a microgel of an esterifiable scale inhibitor cross-linked with a polyol via ester cross-links comprising:

heating, in a reactor vessel, a concentrate comprising water, an esterifiable scale inhibitor, a polyol and a strong acid catalyst under conditions of high shear thereby cross-linking said scale inhibitor and forming a microgel having a mean particle
10 diameter of less than 1 micron.

10. A process as claimed in Claim 9 wherein the shear rate in the reactor vessel is at least 1 ms^{-1} , preferably, at least 5 ms^{-1} .

11. A process as claimed in Claims 9 or 10 wherein the particles of the microgel have a mean diameter in the range 100-750 nm, preferably 200-500 nm.

15 12. A process as claimed in any one of claims 9 to 11 wherein the concentrate additionally comprises a surfactant.

13. A process as claimed in any one of Claims 9 to 12 which further comprises coating the particles of the microgel with a polymer or wax which dissipates in water or oil above a threshold temperature.

20 14. A process as claimed in any one of Claims 9 to 13 wherein the microgel is dried to form a dispersible powder comprising microparticles of the esterifiable scale inhibitor crosslinked with the polyol.

15. A process for preparing particles of an esterifiable scale inhibitor cross-linked with a polyol via ester cross-links comprising the steps of:

25 a) heating, in a reactor vessel, a concentrate comprising water, an esterifiable scale inhibitor, a polyol, and a strong acid catalyst under low shear conditions thereby forming a macrogel of the esterifiable scale inhibitor cross-linked with the polyol;

b) drying the macrogel to form a solid; and

30 c) comminuting the solid to give particles of esterifiable scale inhibitor cross-linked with polyol having a mean particle diameter of less than 1 micron.

16. A process as claimed in Claim 15 wherein the shear rate in the reactor vessel is

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less than 0.1 ms^{-1} , preferably less than 0.005 ms^{-1} .

17. A process as claimed in Claims 15 or 16 wherein the dried solid contains less than 0.1 % by weight of water, more preferably less than 0.05 % by weight of water.

18. A process as claimed in any one of Claims 15 to 17 wherein the comminuted particles have a mean diameter in the range 100-750 nm, more preferably 200-500 nm.

19. A process as claimed in any one of Claims 15 to 18 wherein the solid is comminuted in the presence of a polymer which coats the exposed surfaces of the comminuted particles.

20. A suspension comprising particles of an esterifiable scale inhibitor cross-linked with a polyol as defined in any one of Claims 1 to 8 dispersed in a liquid medium.

21. A suspension as claimed in Claim 20 wherein the liquid medium is an oil, an organic solvent or water.

22. A suspension as claims in Claims 20 or 21 wherein the amount of particles dispersed in the liquid medium is the range of from 20 to 50% by weight.

23. A method of inhibiting scale formation in a subterranean formation comprising:
(a) injecting a suspension comprising particles of a controlled release scale inhibitor suspended in an aqueous medium into a formation through an injection well wherein the particles have a mean diameter of less than 1 micron;

(b) allowing the suspension to percolate through the subterranean formation towards a production well; and

(c) controllably releasing the scale inhibitor from the particles in the near well bore region of the production well.

24. A method as claimed in Claim 23 wherein the particles comprise an esterifiable scale inhibitor crosslinked with a polyol through ester cross-links as defined in any one of Claims 1 to 8.

25. A method as claimed in Claim 24 wherein the particles start to release the scale inhibitor through hydrolysis of the ester cross-links at a temperature of 50 to 150°C .

26. A method as claimed in any one of Claims 23 to 25 wherein the suspension propagates through the formation at a rate of 15 to 100 feet per day.

27. A method as claimed in any one of Claims 23 to 26 wherein the injection well is 0.25 to 1 mile from the production well.

28. A method as claimed in any one of Claims 24 to 27 wherein the esterifiable

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scale inhibitor cross-linked with a polyol is continuously dosed into the injection water in an amount in the range 0.01 to 2 weight percent, preferably 0.01 to 0.1 weight percent.

29. A method as claimed in any one of Claims 23 to 28 wherein the amount of scale inhibitor released into the production water is preferably in the range 1 to 200 ppm.

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